



2  
AD

MULTICHIP MODULE  
HIGH SPEED TESTING

ARPA/ONR  
Grant N00014-91-J-4045

Quarterly Progress Report  
April 1, 1993-June 30, 1993

DTIC  
ELECTE  
JUL 13 1993  
S A D

Robert J. Davis and David H. Auston, Principal Investigators  
Department of Electrical Engineering  
Columbia University  
New York, NY 10027

Progress in the testing of multichip module electronic circuit packages for the period April 1, 1993 - June 30, 1993 is described below, in the areas of the testing of multichip modules using electrooptic polymers, the testing of high-speed transmission line structures, and the microfabrication of fiber optic test probes.

*Electrooptic Polymer Testing*

Earlier, we reported the first real-time electrooptic signals using an electrooptic copolymer system of poly (methyl methacrylate) and a disperse red dye. We have now improved our signal-to-noise ratio to nearly 20 dB at 1 kHz by increasing the optical power (from a 780 nm diode laser) at the electrode gap, by improving the optical alignment, and by reducing noise in the detection electronics. However, the real-time (i.e., not signal averaged) measurements are still limited in speed by the current-to-voltage amplifier, which has a 3 dB frequency of approximately 12 kHz at these settings ( $10^{-5}$  A/V). We are presently finishing the construction of a new high speed amplified differential detector which will both decrease detection noise and increase the usable frequency response to approximately 60 MHz.

*Skin Effect Measurements/High Speed Transmission Line Measurements*

We are currently fabricating coplanar waveguide structures for high speed electrooptic measurements. The Au/Au:Ge metallizations are deposited on GaAs, which is subsequently damaged by ion implantation to reduce the carrier lifetime. Laser pulses can then be utilized to launch and sample voltage pulses along the line. The two transmission line structures

This document has been approved  
for public release and sale; its  
distribution is unlimited.

93-15792



348

have different metallization thicknesses (500 Å and 5000 Å) in order to investigate the dependence of the waveguide properties on the ratio of the metallization thickness to the skin depth.

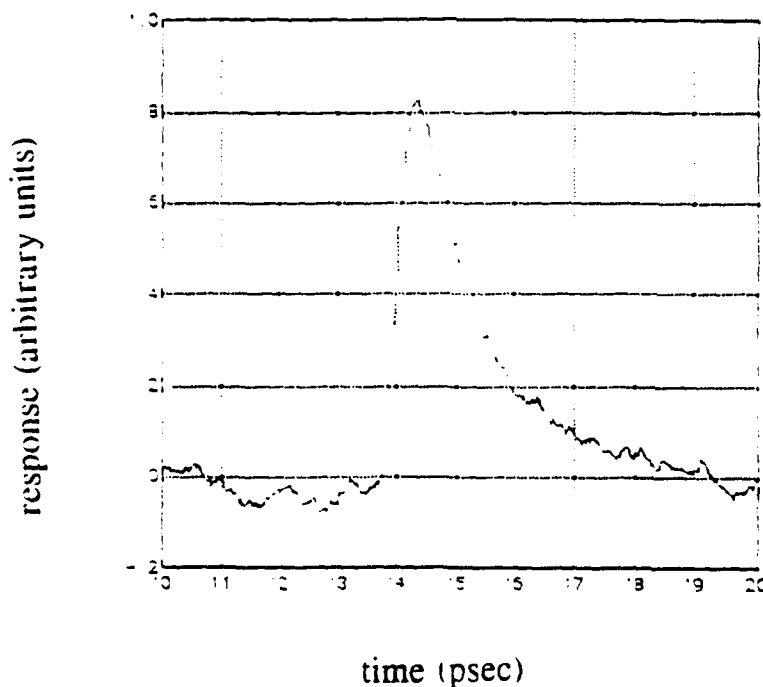
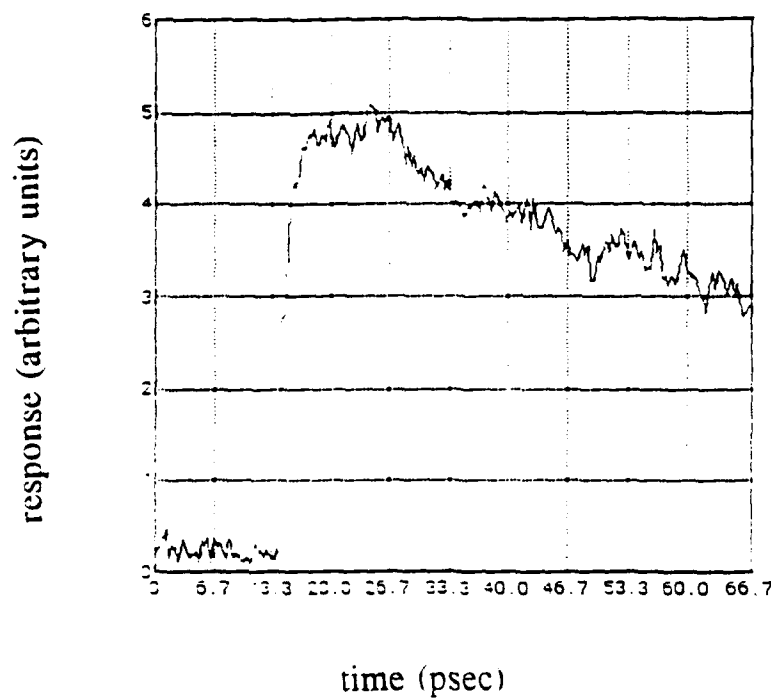
The two samples were ion implanted with high dosages after metals deposition to reduce the lifetime; however, as-implanted samples showed anomalously long carrier lifetimes (see Fig. 1) which may be due to the self-annealing of the GaAs surface during ion implantation at high dosage (and high temperature). However, re-implantation at lower dosage, which presumably results in a lower sample temperature, reduces the lifetime in the surface to approximately 2 psec (see again Fig. 1), demonstrating the need for control of the ion implantation dose in the fabrication of these GaAs electrooptic switches.

#### ***Microfabricated Fiber Optic Test Probes***

We are also working on lithography and materials problems involved in the microfabrication of integrated optical fiber test probes; these probes will integrate photoconductors, and perhaps capacitors, onto optical fibers for use as highly isolated high speed probes for the launching of electrical pulses into multichip modules. The first metals depositions of Au and Au/Ge adhered well to optical fibers which had been stripped of their outer optical cladding using methylene chloride. However, the first films of amorphous Si, deposited by plasma enhanced chemical vapor deposition (PE-CVD), showed anomalously high resistivity and no measurable photoconductivity, presumably due to high levels of oxygen or nitrogen impurities. We are currently planning to use low pressure CVD to deposit the amorphous or polycrystalline silicon, or to deposit layers of germanium using electron beam deposition facilities which are available to us at IBM-Research.

#### ***Personnel***

Pankaj Jha and Jae Choue, graduate students in Applied Physics, joined the project at the end of May working under Prof. Davis.



DTIC QUALITY ASSURED

Accession For	
NTIS CRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By <i>pn A262989</i>	
Distribution	
Availability Codes	
Dist	Avail and/or Special
<i>A-1</i>	

**Fig. 1** Carrier lifetime in ion implanted, damaged GaAs, as measured by reflectivity measurements. In samples implanted at high dosage (top), the carrier lifetime is quite long, probably due to the annealing of the surface at high temperatures. Samples re-implanted with the same total dose (bottom), except at lower dosage, display the expected reduced lifetime. Thus, annealing of the GaAs surface during ion implantation must be considered in the fabrication of high speed radiation damaged GaAs electrooptic switches.